the pipeline by the cathodic protection circuits, the pipe-to-soil potential will tend toward the negative, preventing corrosion from forming. This is referred to as the "on" potential. Various criteria are used in the industry to determine if the pipe-to-soil potential has been shifted sufficiently negative to prevent corrosion. The most common criterion is that the potential difference, while the cathodic protection circuits are switched on, is more negative than −0.85V.

[0012] Each cathodic protection circuit with a rectifier will have an influence along a particular length of the pipeline, i.e., an area of influence. The current difference between a particular cathodic protection circuit being on or off determines the influence of that cathodic protection circuit on the pipe-to-soil potential at any particular point along the pipeline. When a cathodic protection circuit is turned off, there is a drop in current flow to the pipeline causing an increase in the pipe-to-soil potential measured by the pipe-to-soil measurement unit. This change in pipe-to-soil potential or influence of a particular rectifier can be measured with a portable pipe-to-soil measurement unit at each test station by measuring the pipe-to-soil potential with a rectifier switched on and measuring it with the rectifier switched off. The difference between these two values is the influence that the switched on rectifier has on the pipe-to-soil potential. The influence will depend upon the size of the rectifier and how much power it is sending into the soil as well as the local soil condition for current flow. The condition of the coating on the pipeline is also a factor.

[0013] By measuring the influence of each rectifier at each test station, it is therefore possible to obtain a profile of the influence of each rectifier along the pipeline. The information obtained from measuring the influence of individual rectifiers is used for specialized troubleshooting of cathodic protection systems and it is not typically used as a routine monitoring procedure.

[0014] Routine monitoring of cathodic protection systems is important to ensure that the protected structure remains in good condition. Basic routine monitoring of CPSs determines the measured status of the CPSs and includes 1) checking that all rectifiers are functioning and supplying current to the structure and 2) checking that the pipe-to-soil potential with all the rectifiers in the "on" position, is maintained at a value more negative than −0.85V using a copper/copper sulfate reference electrode at all test stations along the length of the structure. If, when using a copper/copper sulfate reference electrode, the pipe-to-soil potential is more negative than −0.85V, the steel pipeline is receiving corrosion protection.

[0015] Instead of physically visiting rectifiers to check that they are functioning and supplying current to the structure, devices known as "remote monitoring units" or RMUs may be used to remotely monitor the rectifiers from a central location. These devices use some form of communication method to automatically transmit the measured status of a rectifier to a central location. A typical remote monitoring device for rectifiers using Low Earth Orbital (LEO) satellites as the communication link is described in U.S. Pat. No. 5,785,842.

[0016] Typically, RMUs are installed inside each rectifier of a cathodic protection circuit. This allows the RMU to remotely read the status of the rectifier and the pipe-to-soil potential at the rectifier. The most common problem associated with the remote monitoring devices is failures that occur as a result of electrical surges, either from the alternating current (AC) supply within the rectifier or through the connection to the pipeline or the connection to the anodes. The remote monitoring described above also has the disadvantage that information on the cathodic protection (CP) status at the rectifier is limited; because the rectifier is the point source of current being supplied to the pipeline, and therefore the pipe-to-soil potential at that point will invariably be satisfactory. Pipe-to-soil potentials of −2V to −3V are very typical. As a result, the CP engineer has to rely on manual pipe-to-soil readings at test stations to ensure that a good CP profile exists along the pipeline.

[0017] Because cathodic protection remote monitoring devices installed in rectifiers do not monitor the pipe-to-soil potential along the pipeline, manual testing to determine the pipe-to-soil potentials along the pipeline is necessary in addition to monitoring the rectifier itself to ensure proper functioning of CPSs. Typically, manual pipe-to-soil potential data at test stations is limited to monthly or annual evaluations, so CPSs may be incorrectly preventing corrosion for some period of time before damage is detected. Furthermore, remote monitoring devices are susceptible to failure caused by electrical surges, thereby decreasing the usefulness of these devices to monitor the proper functioning of the rectifiers. Manual testing of pipe-to-soil potentials along the pipeline and repairing remote monitoring units damaged by electrical surges is expensive, time-consuming and produces dated information. Despite the known deficiencies possessed by current RMUs, to date no one has developed an arrangement that correctly obtains information about the pipe-to-soil potential along the pipeline, while simultaneously determining the status of rectifiers and also preventing failure from electrical surges. More specifically, to date no one has developed a remote monitoring arrangement that utilizes rectifier influence data to determine the status of rectifiers.

[0018] One way of protecting components susceptible to damage by electrical surges is to electrically disconnect the components from the source of the surge during times when the device is not used. A normal switch (e.g. a relay) may not be sufficient because if the surge is big enough, it will jump across the air gap or arcing will occur between one contact and the relay circuitry. A disconnect device has been described in U.S. Pat. No. 5,453,899 that senses the presence of an electrical storm and then unplugs the electrical apparatus from the AC power if an electrical storm is detected. In this case, arcing is avoided by placing a dielectric material between the contact points after the apparatus is disconnected.

[0019] In order to determine the influence from individual rectifiers, it is necessary to (1) switch each of the rectifiers off and measure the pipe-to-soil potential at each test station and then (2) switch each of the rectifiers back on and measure the pipe-to-soil potential at each test station. The shift of the pipe-to-soil potential from off to on for each individual rectifier can then be determined at each test station. Instead of manually switching each rectifier off and on, it is common in the CP industry to install a current interrupter into the rectifier under investigation. By installing an interrupter into a rectifier, it is therefore possible to visit each of the test stations and measure the influence of the rectifier being interrupted. A current interrupter is a device